23.0 SOUTHERN OREGON NORTHERN CALIFORNIA COAST COHO ESU

23.1 BACKGROUND

23.1.1 Description of the ESU

The Southern Oregon Northern California Coast Coho (SONCC) Evolutionarily Significant Unit (ESU) extends from Cape Blanco in southern Oregon to Punta Gorda in northern California, and includes all naturally spawned populations of coho salmon in accessible river and tributary reaches within the ESU. Oregon stocks included in the ESU are from the Rogue River basin and Elk River. California stocks included in the ESU are from the Klamath, Trinity, and Eel river basins; the Smith and Mad rivers, and Redwood Creek. Historically the ESU may have included one or more populations originating in areas above the Lost Creek, Applegate, Elk Creek, Iron Gate, Copco, Trinity River and Lewiston dams. Also included in the ESU are the artificially propagated coho salmon stocks (and their progeny) from the Cole M. Rivers Hatchery, Iron Gate Hatchery, and Trinity River Hatchery. There are currently no other anadromous hatchery coho salmon propagated within the SONCC ESU.

23.2.2 Status of the ESU

The SONCC ESU was listed as a threatened species on May 6, 1997 (62 FR 24588), due to the depressed numbers of naturally-produced coho salmon, the number of environmental and human-caused threats to the species including hatchery impacts, and the lack of adequate regulatory protection to conserve the ESU. Historical abundance for the SONCC was estimated to have been between 150,000 and 400,000 fish, reduced to 10,000 by 1995. Weitkamp *et al.* (1995) noted that run estimates taken from seine surveys at the mouth of the Rogue River had increased from 450 to 19,200 naturally-produced coho salmon adults between 1979 and 1991, while California populations were less than 6 percent of their 1940 abundance and had declined by 70 percent since the 1960s (CDFG 1994). Annual spawning escapement to the Klamath River system in 1983 was estimated to range from 15,400 to 20,000 by the U.S. Commission for Fish and Fisheries in 1892. These estimates, which include hatchery stocks, were less than 6 percent of their abundance in the 1940s (CDFG 1994). Adult returns to the Klamath River basin reflect an 88 percent decline from 1965 to 1991 (CDFG 1965; Brown *et al.*1994). Historically, the majority of coho salmon spawning took place in the Scott, Shasta, and Salmon rivers and numerous other tributaries (Kruzic and Bryant 1998). The Shasta River fish facility has documented 291 coho salmon in 2001 and 86 in 2002, while coho salmon juveniles have been captured in Scott River mainstem trapping efforts (CDFG 2002b). Coho are reportedly scarce in the Salmon River (Elder *et al.* 2002). On an annual basis, the estimated percentage of historical California coho salmon streams in the SONCC for which coho salmon presence was detected has fluctuated between 36 percent and 61 percent for brood years 1986 through 2000 (BRT 2003b). Despite the pattern of variable occupancy rates, there has been no extreme change in the percent of coho salmon streams occupied from the late 1980s to the present (BRT 2003b). Recent attention has been focused on possible effects of the large hatchery program on the sustainability of natural populations in the Rogue and Klamath/Trinity river basins. Other factors identified by

the BRT as risks to the ESU include the apparent frequency of local extinctions; long-term downward trends in coho salmon viability; degraded habitat and subsequent reduction in carrying capacity; competition, introgression, and domestication effects from hatchery fish; little or no infusion of wild genes into the hatchery programs; out-of-basin straying by large numbers of hatchery fish; and historical and reciprocal transfers of inter-basin stocks. In the assessment of the ESU, two-thirds of the BRT voted for the category "likely to be endangered" and a majority of the remaining votes were cast for the "danger of extinction" category (BRT 2003b). The BRT expressed serious concerns over ESU abundance, productivity, and spatial structure; and substantial concerns for ESU diversity.

23.2 ASSESSMENT OF HATCHERY PROGRAMS

The ESU includes a number of extant populations. Additionally, the coho salmon (and their progeny) from the artificially propagated stocks at Cole M. Rivers Hatchery, Iron Gate Hatchery, and Trinity River Hatchery programs are considered part of the listed SONCC ESU. There are currently no other anadromous hatchery coho salmon being propagated within the SONCC ESU. The following section presents a summary of the broodstock/program history, similarity between hatchery origin and natural origin fish, program design, and program performance of these artificial propagation programs (Table 23.1).

Table 23.1. Artificial Propagation Programs which release coho salmon within the geographical area of the SONCC ESU.

Program	Type	Included in ESU	Description	Production Level	Year Initiated
Cole Rivers Hatchery	integrated	yes	yearling smolt	200,000	1974
Iron Gate Hatchery	integrated	yes	yearling smolt	75,000	1965
Trinity River Hatchery	integrated	yes	yearling smolt	500,000	1960

23.2.1 Klamath River

Klamath River coho salmon had once ascended Klamath River and its tributaries to Klamath Falls, Oregon, but are now restricted by Iron Gate Dam (Moyle 2002, *cited in* Israel and Williamson, 2003). The Klamath Basin coho also has shown great declines in abundance since the middle of the 20th century. Although no reliable population estimates are available, direct observation of spawning runs indicates that native coho are present only in small numbers. The Klamath River coho salmon population is affected by the Iron Gate Hatchery (IGH) artificial propagation program which releases its annual coho salmon production within the Klamath River basin. The IGH program integrates local, native fish into its broodstock, and has exclusively used fish returning to the hatchery as of 1977. The IGH program is considered part of the SONCC ESU.

23.2.1.1 Program History. Artificial propagation at IGH began in 1965 as mitigation for Iron Gate Dam. The coho salmon program is funded by Pacific Power & Light Company (PacifiCorps) and is managed by the California Department of Fish and Game (CDFG). The program was designed to supplement Klamath River coho salmon with the estimated number of fish lost from natural production through habitat impacts from the construction and operation of the Klamath Hydroelectric Project (KHP) and loss of 16 miles of spawning gravel between Copco Dam and Iron Gate Dam (SHAGG 2003; Israel and Williamson 2003).

There is no developed monitoring and evaluation plan to provide feedback for adaptive management of the IGH coho salmon program. The number of coho salmon returning to the Iron Gate Hatchery are highly variable and have ranged from 0 fish in 1964 to 2,893 fish in 1987 (K. Rushton, CDFG, *pers. comm*.). A Hatchery and Genetic Management Plan (HGMP) will be developed for the coho salmon hatchery program, in conjunction with the section 7 consultation on the Klamath Hydroelectric Project (Project). Impacts from the hatchery program on the natural population will result in changes regarding the program.

IGH broodstock was originally founded from Trinity River and Cascade River fish, and an unidentified stock. Only Klamath River stocks have been released at the hatchery since 1977, and some local, native fish are included in the program broodstock. The Klamath River itself has been planted with hatchery stocks from the Trinity River, Darrah Springs and Mad River hatcheries (SSHAG 2003).

23.2.1.3 Similarity between Hatchery-origin and Natural-origin Fish. Through microsatellite DNA analysis, it has been determined that IGH coho salmon group closely with the TRH and Trinity River stocks within the Northern group of SONCC genetic structure, distinct from the Southern coho samples (SSHAG 2003). It is believed that the IGH coho salmon may be somewhat diverged from the local natural populations, and influenced by previously introduced non-local stock (SSHAG 2003). Historical coho salmon run timing is October to December, peaking in November; current escapement to IGH peaks in November to mid-December, attributed to the hatchery location at the upper range of coho salmon distribution (K. Rushton, CDFG, *pers. comm*.). The natural coho salmon life history consists of a three-year cycle. Adults spawn in tributary streams and juveniles rear in the streams and rivers for the first 15 to 20 months before migrating out to the ocean. Precocial coho salmon return at two years of age. Parr smolts begin migrating downstream in the Klamath basin between February and mid-June. Hatchery coho salmon spend the first 15 months in the hatchery facility before their release as smolts, to facilitate their movement directly to the sea. This has been confirmed at the screw trap in the Orleans estuary, where 60-70 percent of the trapped smolts are of hatchery origin. It is unknown if the incidence of 2-year old grilse returns to IGH is reflected in the natural population. Limited information exists for Klamath River coho salmon adult returns, due to the difficulty in maintaining census operations under high flow conditions (CDFG- NOAA Fisheries, 2001).

23.2.1.4 Program Design. The goals for the IGH coho salmon program include the production of 75,000 yearling coho salmon, which are released at 10-20/lb., between March 15th and May 1. Current production goals do not include coho salmon conservation. Only Klamath River fish

entering the hatchery volitionally may be used as program broodstock. IGH production goals are based on estimated loss of historical production above Iron Gate Dam. Broodstock are collected randomly throughout natural run timing, and includes the incorporation of natural coho in the ratio of their occurrence in hatchery returns (10-50 percent). Releases of IGH coho salmon have decreased from approximately 147,000 fish (1987-1991) to 72,000 fish (1997-2002). Adult returns have ranged between 4,097 (92 percent natural) to 169 fish (91 percent hatchery), averaging 1737 coho salmon returns between 1996 and 2003. Natural fish are integrated into IGH broodstock in the ratio of their incidence in fish numbers entering the hatchery, 6 percent to 100 percent over the last eight spawning seasons (K. Rushton, CDFG, pers. comm.). Coho salmon that enter the hatchery in excess of broodstock needs are culled, following CDFG policy. As of 1997, all IGH-produced coho salmon juveniles are externally marked by a left-maxillary clip.

23.2.1.5 Program Performance. The IGH coho salmon program will continued to be funded by PacifiCorps for the duration of its continued operation. There are no reliable time series of natural adult migrants or spawners for SONCC ESU rivers (BRT 2003b), or a monitoring component to evaluate the mitigation program and its effects on the natural population. Spawning and carcass surveys specific to coho salmon are not conducted in the Klamath River basin, as seasonal high flow conditions prohibit sampling for most of the adult coho salmon run. Information on juvenile outmigration is collected at the Big Bar trapping site in the Klamath River (USFWS 2002). An abundance index is extrapolated from coho salmon numbers trapped each season. Age 0 coho salmon comprised 73 percent, natural age 1+ fish comprised 17 percent and hatchery fish age 1+ comprised 11 percent (range 6 percent to 17 percent) of the total fish outmigrating in the 1997 through 2000 seasons. The low incidence of age 1+ coho salmon in the Big Bar trap reflects the late start-up of operations into the yearling migration, and the success of the larger fish in evading the trap. The estimated abundance index for all four seasons totaled 16,106 fish, derived from 152 trapped coho salmon. Coho salmon age 0 were captured from late February to early July. Coho salmon age 1+ (natural and hatchery) were captured in early May to mid-June. IGH releases their coho salmon yearlings in late March. Release to return survival rates and cohort replacement rates have not been calculated for the IGH coho salmon program.

Continued operation of the IGH coho salmon program is uncertain. There is a strong indication that the program, as currently operated, may be hindering the recovery of the natural coho salmon population. Consideration is being given to its continuation, reduction or conversion to a conservation program, through the FERC relicensing process for KHP.

23.2.1.6 VSP Effects. Based on incidental field information and the composition of adult escapement to the hatchery, the majority of returns are of hatchery origin. There has been an increase in numbers of unclipped coho salmon entering the hatchery 2001-2003, which may be partly due to increasing contribution of hatchery fish to the spawning population or to beneficial ocean conditions, or a combination of several factors. Until there is a monitoring program for coho salmon in the Klamath River, it will be difficult to corroborate hatchery contribution to population productivity. There is the possibility that the IGH program is having an adverse effect on the survival of wild juveniles through competitive and aggressive interactions by hatchery fish. It is not known if population spatial structure has benefited from hatchery fish, although it

appears that SONCC populations have stabilized overall at a low level since the late 1980s (NRC 2003).

23.2.2 Trinity River

Natural coho populations have experienced an approximate reduction of 96 percent in the Trinity River, reduced to a few hundred individuals (NRC 2003; CDFG 2002a). The natural coho salmon populations are affected by the Trinity River Hatchery (TRH) artificial propagation program which releases its annual coho salmon production within the Trinity River basin. The TRH program integrates local, native fish into its broodstock, and has exclusively used fish returning to the hatchery as of 1977. The TRH program is considered part of the SONCC ESU.

23.2.2.1 Broodstock History. Artificial propagation at TRH began in 1960 as mitigation for the loss of 109 miles of habitat above Lewiston dam. The program is funded by the U.S. Bureau of Reclamation, and is managed by CDFG. The goals of the TRH program do not include coho salmon conservation. The TRH stock was originally founded with local native fish stock from the Eel, Cascade, Alsea and Noyo rivers, but has exclusively used returns to the hatchery since 1970 (Israel and Williamson 2003). Local, native fish are integrated into TRH broodstock in the same ratio as the composition of hatchery and natural fish numbers entering the facility (<10 percent). A Hatchery and Genetic Management Plan (HGMP) will be developed for the coho salmon hatchery program, in conjunction with the section 7 consultation on the Klamath Hydroelectric Project (Project). Impacts from the hatchery program on the natural population will result in changes regarding the program.

23.2.2.2 Similarity between Hatchery-origin and Natural-origin Fish. Through microsatellite DNA analysis, it has been determined that the TRH stock clusters with the IGH and Trinity River stocks within the Northern group of SONCC genetic structure, distinct from the Southern coho samples. However, TRH coho salmon are also genetically distinct from Deadwood Creek, Trinity River, and IGH stocks. Run timing and spawn timing are the same for both hatchery and natural fish. Coho salmon life history consists of a three-year cycle. Adults spawn in tributary streams and juveniles rear in the streams and rivers for the first 15 to 20 months before migrating out to the ocean. Precocial coho salmon return at two years of age. Hatchery coho salmon spend the first 15 months in the hatchery facility before their release as smolts, on the assumption that they will head directly to the sea. Both TRH and natural coho salmon were recovered in a 2001 spawning survey, exhibiting the same run timing and spawning period.

23.2.2.3 Program Design. The TRH coho salmon program volitionally releases an average of 525,000 fish between March 15 and May annually (NRC 2003). The carrying capacity of the Trinity River basin is not known, but historical returns has been estimated at 8,000 coho salmon (BRT 2003b). Numbers were reduced to1,700 and 3,100, in 1990 and 1991, respectively. Current production goals do not include coho salmon conservation. Only Trinity River fish entering the hatchery volitionally may be used as program broodstock. Broodstock are collected randomly throughout natural run timing, and may include the incorporation of natural coho salmon, in the ratio of their occurrence in hatchery returns (<1-10 percent). However, due to overwhelming numbers of hatchery fish and low natural productivity in the Trinity River basin, the number of

natural fish that may enter the hatchery is very low. Coho salmon in excess of broodstock needs are culled, based on CDFG, policy. TRH production goals are based on the estimated loss of historical adult returns above Lewiston Dam. As of 1994, all TRH-produced coho salmon juveniles are externally marked by a right-maxillary clip. The Hoopa Valley Tribe is exploring the feasibility of 100 percent thermal marking of all TRH fish to supplement external marking, and improve the accuracy and precision of in-river run size and migratory timing estimates for hatchery and natural fish in juvenile out-migrations and adult returns.

Continued operation of the TRH coho salmon program will continue. There is a strong concern that the large numbers of coho salmon that the program currently releases needs to be evaluated in terms of the recovery and/or restoration of natural Trinity River coho salmon populations. Consideration is being given to its continuation, reduction or conversion to a conservation program, through the FERC relicensing process for KHP.

23.2.2.4 Program Performance. The percentage of coho salmon escapement entering the hatchery ranges from a low of 22 percent in 1998 to high of 34 percent in 1994, with an annual average of 32 percent since 1986 (Kruzic and Bryant 1998). Fish numbers range between 23,338 (1987) to 294 fish (1995), averaging 6115 coho salmon returns between 1986 and 1998. TRH coho salmon naturally stray within the basin (BRT 2003; CDFG-NOAA Fisheries 2001), and have been found with natural fish in the 2001 Trinity River carcass survey (NRC 2003; Sinnen 2002). Most of the 692 coho salmon carcasses were found in the greatest concentration in the uppermost reach near Lewiston Dam (Sinnen 2002). An estimated 75.9 percent of the mainstem spawners were of hatchery origin. Outmigrant trapping of juvenile coho salmon on the lower Trinity River has indicated that 65-97 percent of the 1998-2000 catch were hatchery fish, and an estimated 85-95 percent of the 1997-2001 in-river spawners upstream of the South Fork Trinity River were stray fish from TRH. There is a dichotomy in size between hatchery and natural migration. Hatchery fish reach the estuary at the same time as wild smolts, in late May and early June, arriving at 170-185 mm in length compared to 135–145 mm of wild fish (NRC 2003).

Information on juvenile outmigration is collected at the Willow Creek trapping site in the Trinity River (USFWS 2002). An abundance index is extrapolated from the numbers of coho salmon trapped each season. Age 0 coho salmon comprised 7 percent, natural age 1+ fish comprised 7 percent and hatchery fish age 1+ comprised 86 percent (range 62 to 92 percent) of the total fish outmigrating in the 1997 through 2000 seasons. Coho salmon age 0 were captured from late February to early July. Coho salmon age 1+ (natural and hatchery) were captured in early May to mid-June. TRH releases their coho salmon during late March. The low incidence of age 1+ coho salmon in the Willow Creek trap reflects the success of the larger fish in evading the trap. The estimated abundance index for all four seasons totaled 182,294, derived from 2,813 trapped coho salmon. Release to return survival rates and cohort replacement rates have not been calculated for the TRH coho salmon program.

23.2.2.5 VSP Effects. The majority of juvenile coho salmon out-migrating from the Trinity River basin are hatchery stock; 85-95 percent of the few naturally-spawning fish are hatchery adult returns (CDFG 2002a). There may be outbreeding effects due to the large numbers of hatchery fish in the system (SWFSC 2001), with little infusion of wild genes in the hatchery population,

resulting in selection for domestication (Israel and Williamson 2003). A high straying rate by hatchery coho salmon poses likely introgression with natural fish in the Trinity River basin, impacting the natural genome. There may be outbreeding effects due to large numbers of hatchery fish in the system (SWFSC 2001). An initial 2001 coho salmon carcass survey did not cover any Trinity River tributaries, which are the preferred spawning habitat for coho salmon. It is not known if hatchery fish are contributing to the expansion of population spatial structure. TRH has been recognized as having the potential to be used in restoration work, due to the absence of any known natural population in the Trinity River system (CDGF-NOAA Fisheries, 2001).

23.2.3 Rogue River

The TRT for the SONCC coho salmon ESU has not published their population designations at this time. The Rogue River may have more than one population of coho salmon. For the purposes of this assessment, the entire run in the Rogue River was considered.

23.2.3.1 Broodstock History. The current broodstock was founded in 1974 from returns to Cole Rivers hatchery, at the base of Lost Creek Dam, the uppermost extent of salmon migration in the Rogue River. Since the late 1990's significant numbers of natural coho salmon have been incorporated into the broodstock. In some years, the broodstock was comprised of all natural fish. The management goal is to incorporate at least 30% natural fish into the broodstock annually.

23.2.3.2 Similarity between hatchery origin and natural origin fish. The hatchery stock is being managed as a “wild type” broodstock. The intent is to collect broodstock in a manner that represents the run timing, spawn timing, and length distribution of the natural coho run in the Upper Rogue River (ODFW 1998). Genetic samples of the hatchery stock clustered with other natural coho stocks included in the SONCC ESU (Weitkamp *et al.* 1995). Returning hatchery and natural coho salmon above Gold Ray Dam exhibit similar run timing, adult age distribution, and length.

23.2.3.3 Program Design. This program is intended to mitigate for fishery losses from the construction of Lost Creek dam on the Rogue River. All of the hatchery fish are adipose fin clipped for recreational fisheries in the ocean and Rogue River. Program fish are not used to supplement natural spawning in the basin. The goal is to have less than 10% of the natural spawners being of hatchery origin (ODFW 1998).

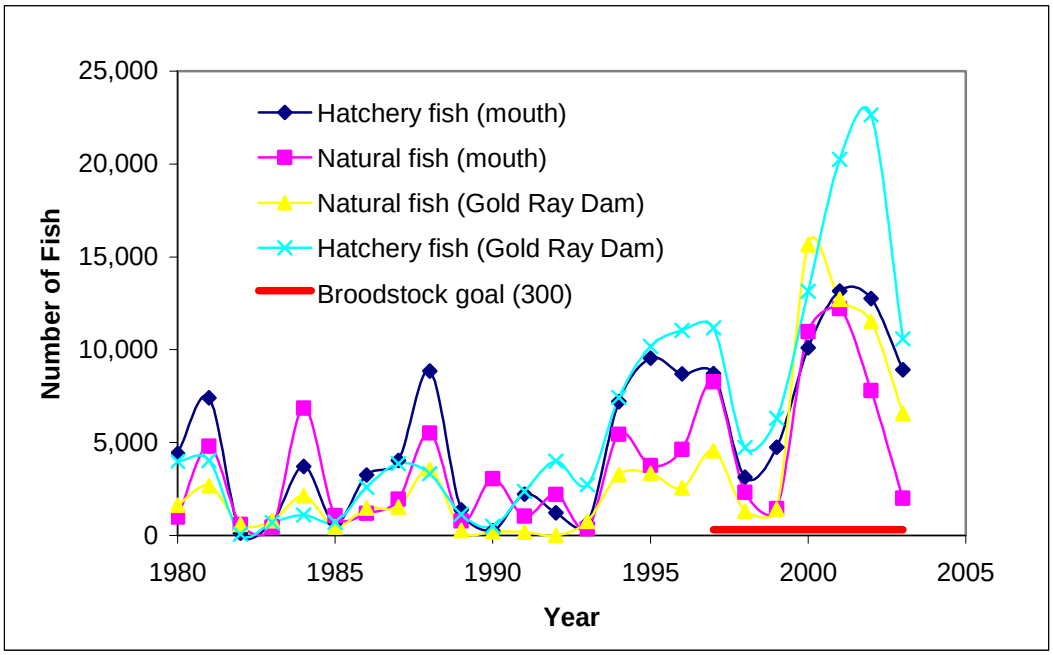
23.2.3.4 Program Performance. The smolt to adult survival rate of the Cole Rivers hatchery stock has averaged 3.0% for brood years 1987-1996 (ODFW 1998). The broodstock goal for the current production level is approximately 300 fish. Total returns of coho salmon to the hatchery trap have exceeded the broodstock goal every year since the program was initiated. The program is funded by the Corps of Engineers and ODFW. The long-term funding outlook for this program is very certain.

23.2.3.5 VSP Effects

Abundance - Long term run estimates of coho salmon are available from Gold Ray Dam. From 1942 to 2003, an average of 2,200 natural fish passed the dam. In the last two decades the run of coho salmon has steadily increased (Figure 23.1), with the highest runs on record occurring in 2000 through 2002. The average number of hatchery coho salmon crossing Gold Ray Dam from 1980 to 2003 has been 6,200 fish.

Spawning surveys have shown hatchery fish to represent less than 10 percent of the spawners throughout the Rogue Basin in recent years (ODFW 1998). The releases of hatchery fish in the Rogue River have been reduced over the last decade.

Figure 23.1. Estimated return of coho salmon to the mouth of the Rogue River and Gold Ray Dam (located upstream approximately 150 miles), and the current broodstock goal.



Sufficient numbers of natural and hatchery coho salmon return back to the hatchery every year for broodstock needs. In the last few years, the natural run of coho salmon has been high and the hatchery has used solely natural fish for broodstock. The broodstock is being managed as a wild-type broodstock. The program is providing a genetic reserve of the coho run above Gold Ray Dam that may be used in the future for recovery purposes if the natural run becomes depressed.

Productivity - Given the relatively low number of fish released in the Rogue River and the low proportion of the natural spawners being hatchery fish, it is not likely the program is benefiting the productivity of the natural run.

Spatial Structure - The hatchery is located at the base of Lost Creek dam, an impassable dam with no anadromous fish production above the reservoir. Hatchery fish are not being outplanted to any areas in the Rogue Basin. There is little to no effect of the hatchery program on the spatial structure of the natural run.

Diversity - The hatchery program incorporates natural coho into the broodstock on a regular basis. The intent is to collect broodstock that mimics the run timing, spawn timing, and body length of natural fish returning to the local area.

23.3 CONCLUSION

Existing Status: Threatened
BRT Finding: Threatened
Recommendation: Threatened

23.3.1 ESU Overview

23.3.1.1 History of Populations

The Technical Recovery Team for this ESU has not published their list of historic populations. Current abundance of natural coho salmon in the ESU is substantially below historic levels in California rivers (BRT 2003). The run of coho salmon in the Rogue River has exhibited a positive trend over the last 20 years. Little information is available from other rivers in Oregon. Coho salmon populations in the Klamath Basin have declined precipitously over the last 60 years and coho salmon presence in the Klamath and Trinity Rivers is primarily from hatchery production.

23.3.1.2 Association between Natural Populations and Artificial Propagation

Natural populations "with minimal genetic contribution from hatchery fish"

There are three hatchery programs in the ESU located in the Trinity, Klamath, and Rogue Rivers. These rivers represent a substantial area of the ESU. In the Rogue River, the percentage of hatchery coho salmon on the spawning grounds throughout the basin has been low in recent years. Most of the natural spawning of coho salmon in the Rogue Basin has had minimal spawning from hatchery coho salmon with the exception of the area near Cole Rivers hatchery. The highest percentage of natural spawners that are hatchery fish have been observed here. However, hatchery fish comprise less than 10% of the natural spawners above Gold Ray Dam in recent years. In the other rivers within the ESU besides the Trinity and Klamath Rivers, it is expected that hatchery fish spawning naturally would be minimal.

Return of coho salmon to the Trinity and Klamath Rivers are predominately hatchery coho salmon. Therefore, it is expected natural spawners would be mostly hatchery fish. These areas are heavily influenced by hatchery fish. The Shasta,

Scott, and Salmon Rivers do not have a hatchery presence; coho salmon production from these basins are primarily of natural stock but may be influenced by hatchery fish strays.

Natural[1] populations "that are stable or increasing, are spawning in the wild, and have adequate spawning and rearing habitat" [2]

In the few areas within the ESU where coho salmon returns can be monitored, information suggests returns have increased the last few years. However, the long-term trends over the last 100 years are negative for all of the natural populations. The current abundance in California rivers is estimated to be less than 10% of historic abundance (BRT 2003).

Mixed (Integrated Programs[3])

Trinity, Iron Gate, and Cole Rivers hatchery stocks.

Hatchery (Isolated[4])

None.

23.3.2 Summary of ESU Viability

Abundance

The highest risk factor for this ESU was in the abundance and productivity categories (BRT 2003). The number of natural-origin coho salmon spawners increased in the Rogue River since 1997. The long term trend over the last 20 years for the return of coho salmon in the Rogue River is positive. The current abundance of coho salmon in California rivers is estimated to be less than 10% of historic levels, and exhibit a long-term negative trend (BRT 2003). Most of the natural spawners are of hatchery origin in the Trinity and Klamath Basins.

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[1] See HLP for definition of natural, mixed and hatchery populations

[2] HLP Point 3

[3] Integrated programs follow practices designed to promote and protect genetic diversity and only use fish from the same local population for broodstock (both natural-origin fish, whenever possible, and hatchery-origin fish derived from the same local population and included in the ESU). Programs operated to protect genetic diversity in the absence of natural-origin fish (e.g., captive broodstock programs and the reintroduction of fish into vacant habitat) are considered "integrated".

[4] Isolated programs do not follow practices designed to promote or protect genetic diversity. Fish that are reproductively isolated are more likely to diverge genetically from natural populations included in the ESU and to be excluded themselves from the ESU.

Productivity

The highest risk factor for this ESU was in the abundance and productivity categories (BRT 2003). The long term productivity rate trend for the ESU is negative. The BRT (2003) expressed concern whether coho salmon populations would be able to sustain themselves under current habitat conditions during the next cycle of poor ocean conditions.

Spatial Structure

Much of the historic spawning habitat is still accessible to coho salmon. However, current habitat conditions are degraded and the overall carrying capacity of the streams is reduced (BRT 2003). Several federal dams in the ESU have also blocked access to upstream spawning areas. Hatchery fish are not being outplanted into unoccupied habitat. Operation of the hatchery facilities represents a negligible effect on the overall distribution and migration of juvenile and adult coho salmon in the ESU.

Diversity

All three of the hatchery stocks are integrated with local, natural fish. However, since significant numbers of natural fish have not been incorporated into the Trinity and Iron Gate hatchery broodstocks, there are potential risks from the high numbers of hatchery fish introgressing with natural fish in the wild. It is not fully known what extent the hatchery programs may be having on the diversity of the ESU as a whole.

23.3.3 Artificial Propagation Record

Experience with Integrated Programs

The Trinity, Iron Gate, and Cole Rivers hatchery stocks are integrated with natural origin coho salmon. All of these programs have been in operation for more than a decade.

Are Integrated Programs Self-Sustaining

The Trinity, Iron Gate, and Cole Rivers hatchery programs have exceeded broodstock goals nearly every year since the programs were initiated. Spawner to spawner replacement rates have averaged more than one since the programs have been in operation. See Results Section for further information.

Certainty that Integrated Programs will Continue to Operate

All of the integrated programs are funded by state and federal agencies. Continued funding of the Trinity and Cole Rivers hatchery program is certain since the program is to mitigate for the effects of dams. Continued operation of the Iron Gate coho salmon program is being evaluated within the FERC relicensing of the Iron Gate Project, and may be modified for conservation purposes, reduced in scope, or discontinued.

23.3.4 Summary of Overall Extinction Risk Faced by the ESU

The Southern Oregon Northern California coho salmon ESU faces the highest risks in terms of low abundance and low productivity. All abundance estimates available for the ESU show

current runs to be less than 10% of historic abundance in most of the rivers in California. The stronghold run of coho salmon has been in the Rogue River, which has had an increasing trend over the last two decades. The current hatchery programs are providing some benefit to the abundance of coho salmon in the Trinity, Klamath, and Rogue Rivers. However, significant numbers of naturally spawning hatchery fish in the Trinity and Klamath basins and subsequent effects on the productivity and diversity of natural populations is of major concern.

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